

1874.

QUEENSLAND.

REPORT OF BOARD ON STEAM BOILER EXPLOSIONS.

(Laid upon the Table of the Legislative Assembly by Command, and Ordered to be Printed, 31st March, 1874.)

Surveyor-General's Office,

Brisbane, 28th February, 1874

SIR,

In accordance with your letter of the 4th July, 1873, intimating that His Excellency the Governor had been pleased to appoint us as a Board to inquire into the causes of Explosion of Steam Boilers, and the measures to be adopted for the protection of persons employed in connection therewith, we have the honor to forward a Report embodying the result of our inquiries and investigations.

We have, &c.,

(For the Board,) A. C. GREGORY,

Chairman.

The Honorable the Colonial Treasurer,
&c., &c., &c.

REPORT OF THE BOARD APPOINTED BY HIS EXCELLENCY THE GOVERNOR TO
INQUIRE INTO THE CAUSES OF EXPLOSION OF STEAM BOILERS, AND THE
MEANS AVAILABLE FOR GUARDING AGAINST ACCIDENTS ARISING THERE-
FROM.

THE comparative infrequency of serious accident to Steam Boilers in Queensland, combined with the difficulty of obtaining accurate details in the cases of those explosions which have recently occurred, has rendered it necessary to refer to reports of similar accidents in other countries, and also to the elaborate experiments which have been made for determining the strength and durability of the numerous classes of steam boiler which have been in use.

The principal object of inquiry being to determine the most effective measures available for the reduction of the risks which are inseparable from the use of steam power.

Attention has been especially directed to the practical appliances, which can, without great expense, be adapted to the several classes of steam boiler in use in Queensland, and also to the more difficult question how far a system of inspection, by qualified engineers, appointed by the Government, can be usefully carried out without undue interference with private business, or the removal of responsibility from the owners of engines to the employés of the Government.

The steam boilers in general use in this colony may be conveniently divided into three classes, each requiring different appliances and precautions to ensure a maximum security.

- 1st. The simple Shell Boiler.
- 2nd. Flue Boilers.
- 3rd. Tubular Boilers.

The first class consist of a simple shell, usually in the form of a long cylinder, with rounded ends, a form which gives the maximum strength for the metal used. The fire is altogether external, and there is little risk of the plates being over-heated from deficiency of water; but, as the fire is under the lowest part, the deposits of salt or mud are in the worst position, and great care is necessary in clearing out the deposits; frequently, if the water used is not perfectly free from mud or salt, while neither safety valves, fusible plugs, nor water gauges afford any security from accident, if the sediment is allowed to accumulate.

The second class, or flue boiler, is usually a long cylinder, with a large tube or flue from end to end, and the fire is either placed in the flue or in a furnace at one end. As the action of the fire is first on the flue, which is surrounded with water, and the deposits of mud or salt take place below the flue, this form of boiler is less liable to injury from this cause than the shell boiler, while it is one of the most economical in regard to fuel.

When reasonable care is taken, this form of boiler is safe, and very efficient, and is, perhaps, the most used for stationary engines of more than ten horse-power; but, if the proper supply of water is not maintained, there is great danger of very serious explosion.

If the water in a flue boiler is allowed to fall below the top of the flue, the metal becomes greatly heated, being directly over the fire, and either the plates soften, and the flue is crushed by the pressure, or if the flue is uncovered during a temporary stoppage of work, as during the time workmen are at their meals, as soon as the steam is turned on to the engine, the water in the boiler is thrown, by the expansion of steam, over the heated part, and there results so sudden an accession of steam that no safety valve is adequate to relieve the pressure, and it seems that far the greater number of fatal explosions have resulted in this manner.

Under these circumstances, the precautionary measures to be taken in regard to flue boilers should be directed, especially, to maintaining a sufficient and steady supply of water, or at least to give warning of a deficient supply.

The third class of boiler is tubular, in which the fire is contained in a box surrounded by water, and the heated gas passes through small tubes, which traverse the water in the boiler.

This is the safest form of boiler, and even an insufficient supply of water seldom results in more than the collapse of one of the tubes, the steam, escaping from a small aperture, does not result in a destructive explosion.

The precautionary measures for the prevention of explosion are numerous, but the following are the principal ones which are of practical utility :—

1. Safety valves.
2. Pressure gauges.
3. Glass gauges, showing height of water.
4. Steam whistles, worked by floats, to indicate insufficiency of water.
5. Mechanical indicators, showing level of water worked by floats in boiler.
6. Fusible plugs, which melt when not covered by water in boiler.

Safety valves are applied to all steam boilers, but they only provide against any pressure in excess of the weight placed on the valve under ordinary circumstances of the production of steam, but they cannot be made to relieve the boilers from the excessive pressure in the case of a large quantity of steam suddenly formed, as in the case of an over-heated flue.

Another source of danger connected with the safety valve is, that reckless and ignorant engine-drivers frequently place additional weights on the valve for the purpose of obtaining more power when, through defect in fuel, or any other cause, the amount of work to be done exceeds the power of the engine.

In marine engines there is a second safety valve, securely covered, so that the engineers cannot place any additional weight on it; and this might be adopted in the case of land boilers, excepting, perhaps, tubular boilers under eight horse-power.

Pressure gauges are useful in the hands of experienced men, but they are of little service in the hands of careless engine-drivers.

Glass gauges, which show the actual level of the water in the boiler, are very valuable, and ought to be used in every case. The tubes connecting them to the boiler are liable to be choked with salt if not properly attended to; and there is reason to suppose that this has misled inexperienced persons, and caused serious accidents through insufficient supply of water.

Steam whistles worked by floats inside the boiler have one important advantage, that they not only warn the persons attending to the engine, but also give notice to others, that there has been a neglect of due precaution. Their defect is, that they are very liable to become incrusted with salt or deposit, and fail to work, unless care is taken to keep the apparatus clean.

Mechanical indicators of the height of water in boilers worked by floats are very valuable, and as they are always subject to slight motion, there is less liability of the working parts being clogged with salt. They serve as checks against defects in the glass gauge.

Fusible plugs are inserted in holes in the boiler plates at the lowest level of the water, which is safe, and if the water fall below, they are melted by the heat of the fire, and allow steam to escape. Experience has shown, that though their use should not be neglected, they are not to be relied on, as they are liable to incrustations, which close the holes when the plug has melted.

These several forms of precautionary apparatus are not all equally adapted to every description of boiler.

The safety valve, pressure gauge, and glass tube gauge, should be applied to all.

The alarm whistle and mechanical indicator being worked by floats, are only convenient in the case of the shell boiler, and flue boiler, which have sufficient free water space.

Fusible plugs are well adapted to the fire-boxes of tubular boilers, and the crown of the flue in the flue boiler, but are of little practical use in shell boilers.

Notwithstanding the immense number of steam engines in use in Great Britain, and the facilities which exist for their inspection, the Government have not hitherto deemed it expedient to establish any system of supervision in the case of steam boilers used on land, though marine engines are subjected to rigorous inspection and stringent rules for the prevention of accident.

In Queensland, the wide space over which the steam engines are in use, and the isolation of many, would preclude any complete inspection by officers appointed by the Government, but as the greater proportion of the shell and flue boilers are worked close to centres of population, and more especially the seaports, it would be practicable to establish an effectual supervision of the greater part of the classes of boiler which are most liable to serious accident.

The chief difficulty would be, that if the Government inspectors examined and approved engines, the owners would consider themselves relieved from responsibility in regard to mechanical defects which might exist at the time of survey, and in some cases might relax their care and attention regarding the defects in their machinery; so that inspection, unless very frequent and careful, would tend rather to enhance the danger than to prevent it.

As a very large proportion of the explosions of steam boilers seem to have resulted from want of care or knowledge on the part of those who have charge of the engines, it would be desirable if none but competent men were allowed to be employed; but if none but licensed engine-drivers were allowed to work

work steam engines, very serious loss and delay might result from the illness or refusal to work on the part of an engine-driver, especially in isolated localities where the employment of a large number of men may be dependent on a supply of water pumped by the engine, as in the case of sheep washing.

No doubt owners of steam engines would prefer to employ competent men, and have considerable difficulty in ascertaining whether those who offer their services are competent to do the work.

It might, therefore, be desirable to appoint a board of examiners who should be authorised to issue certificates of competency as engineers or as engine-drivers, such certificates to be liable to suspension or revocation in the case of misconduct or any other sufficient cause.

It is submitted that all steam boilers exceeding one horse-power should be provided with safety valves and glass gauges.

That every steam boiler exceeding eight horse-power be required to have a second safety valve, which should be secured from access by lock or seal, so as to prevent the engine-driver from raising steam above the maximum of such second safety valve.

That all tubular boilers be provided with fusible plugs in the crown of the fire box.

That all flue boilers and shell boilers be provided with fusible plugs on the crown of the flue inside, and at the highest parts of the outside flues, and that they also be provided with an alarm whistle or mechanical indicator of the quantity of water in the boiler.

That a board or department be established to execute the following duties, subject to the approval and general control of the Government:—

- 1st. The appointment and supervision of duly qualified inspectors of steam boilers.
- 2nd. The issue of licenses to work steam boilers after inspection for periods not exceeding one year, such licenses to define the maximum pressure to be allowed.
- 3rd. The issue of certificates of competency as engineers or engine-drivers to persons who, upon examination, shall appear duly qualified, and to suspend or cancel such certificates in the case of wilful carelessness or other misconduct.
- 4th. The issue of regulations defining the precautions to be adopted for each class of steam boiler, times and modes of testing or examining the same, and for any other purpose connected therewith.

The inspectors to be authorised to demand access to any steam boiler or machinery connected therewith, and to require that any boiler in use shall be tested by cold water pressure once in six months.

During the currency of a license, inspectors to have the power to require repairs, adjustments, or the cleaning of any part of the boiler or machinery pertaining thereto, when it shall appear necessary for the prevention of explosion, and to order the maximum steam pressure to be reduced, or to wholly suspend the license, until such requisition is complied with.

That persons using steam boilers of more than one horse-power, who shall neglect or refuse to comply with any regulation for the prevention of accidents, or who shall refuse to allow inspectors to have access to such boilers or machinery, or who shall fail to comply with the conditions of any license, or who shall neglect to comply with any requisition by an inspector to take special precaution, or to make repairs, shall be liable to a penalty not exceeding five pounds, to be recovered before any two justices.

A. C. GREGORY,
Chairman.

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STEAM ENGINES EMPLOYED ON FARMS AND STATIONS IN QUEENSLAND.

Police District.	Number of Steam Engines.	Aggregate Horse Power.
Beenleigh	19	105
Bowen	1	15
Brisbane	35	264
Bundaberg	2	32
Clermont	1	20
Condamine	2	20
Dalby	15	269
Drayton and Toowoomba	9	127
Gladstone	4	42
Gympie	5	65
Ipswich	9	64
Leyburn	8	95
Mackay	24	276
Maryborough	30	394
Mitchell	4	43
Nanango	3	36
Rockhampton	5	38
Roma	8	84
St. George	1	8
Taroom	3	30
Warwick	11	154
Ditto (Stanhope)	4	38
Woogaroo	8	24
TOTAL	211	2,243

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STEAM ENGINES employed upon GOLD FIELDS in QUEENSLAND.

Name of Gold Field.	Number of Steam Engines.	Aggregate Horse Power.
Gilbert Range	2	22
Etheridge and Western Creek	7	74
Cape, Broughton, and Charters Towers	5	89
Ravenswood	10	132
Normanby	1	15
Ridgelands, Morinish, Cawarral, &c.	5	52
Boyne and Calliope	2	28
Cania	1	10
Gympie	7	280
Kilkivan	1	10
TOTAL	41	712

Price 3d.]

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STEAM ENGINES employed in SAW MILLS in QUEENSLAND.

Police District.	Number.
Beenleigh	1
Brisbane	4
Bundaberg	1
Dalby	2
Drayton and Toowoomba	2
Gladstone	2
Gympie	1
Ipswich	1
Maryborough	5
Rockhampton	1
Roma	2
St. George	1
Warwick	3
Woogaroo	1
TOTAL	27

By Authority: JAMES C. BEAL, Government Printer, William street, Brisbane.